BYJU'S Home Learning Program

Topic covered:

- **Mole Concept (Session - 1) - NEET**

Worksheet

1. 10 g of an oxide of X contains 5.0 g of X while 8.0 g of another oxide of the same species contains 3.2 g of X. Which law is indicated in this data?
   a. Law of multiple proportions
   b. Law of conservation of mass
   c. Law of constant proportions
   d. Law of reciprocal proportions

2. Pure samples of water always yield 88.89 % of oxygen and 11.11 % of hydrogen, by mass. This can be explained by using the law of:
   a. Conservation of mass
   b. Constant proportions
   c. Multiple proportions
   d. Reciprocal proportions

3. The law of multiple proportions is illustrated by the pair of compounds:
   a. $Mg(OH)_2$ and MgO
   b. Water and heavy water
   c. NaCl and NaBr
   d. SO_2 and SO_3

4. Consider two compounds of A and B. In one compound, x grams of A combines with y grams of B whereas 2x grams of A combines with 3y grams of B in the second one. The data satisfies:
   a. Law of multiple proportions
   b. Law of conservation of mass
   c. Law of constant proportions
   d. Law of reciprocal proportions

5. An unbalanced chemical reaction is a violation of the law of:
   a. Conservation of mass
   b. Constant proportions
   c. Reciprocal proportions
   d. Multiple proportions

6. Sodium and oxygen combine to form two compounds, one being Na_2O. The amount of sodium in the other compound is 59 % by weight. Find the formula of this compound.
   a. NaO_2
   b. Na_2O_2
   c. NaO
   d. Na_2O

7. Potassium combines with two isotopes of chlorine ($Cl - 35$ and $Cl - 37$) respectively to form two samples of KCl. Their formation follows the law of:
   a. Constant proportions
   b. Multiple proportions
   c. Reciprocal proportions
   d. None of these

8. What is the volume of CO_2 gas obtained on the complete combustion of 30 mL of propane gas?
   a. 10 mL
   b. 30 mL
   c. 90 mL
   d. 40 mL

9. Which of the following represents Avogadro's hypothesis?
   a. Atoms of different elements may combine with each other in a fixed, simple, whole number ratio to form compounds
   b. Equal volumes of all gases under the same temperature and pressure conditions contain an equal number of atoms
   c. Equal volumes of all gases under the same conditions of temperature and pressure contain an equal number of molecules
   d. Gases react together in volumes which bear a simple ratio to one another

10. For which of the following reactions is Gay-Lussac's law not valid?
   a. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$
   b. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
   c. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
   d. $2KClO_3(s) \rightarrow 2KCl\ (s) + 3O_2(g)$

11. Two metallic oxides contain 27.6 % and 30 % oxygen respectively. If the formula of the first oxide is X_3O_4, what will be the formula of the second oxide?
   a. XO
   b. XO_2
   c. X_2O_3
   d. X_2O_5

12. The percentage composition in a sample of $CaCO_3$ is given as: Ca=40%; C=12%; O=48%. What will be the weight of Ca in 4 g of a sample of $CaCO_3$ obtained from another source, if the law of constant proportions is true?
   a. 0.016 g
   b. 0.16 g
   c. 16 g
   d. 1.6 g

13. Which of the following is **not** in accordance with Dalton's atomic theory?
   a. Matter is made up of extremely small indivisible particles called atoms
   b. Atoms can neither be created nor be destroyed in a chemical reaction
   c. Atoms of different elements may combine with each other in a fixed, simple, whole number ratio to form compounds
   d. Equal volume of all gases under similar conditions of temperature and pressure contain different number of molecules

14. The volume of a drop of water is 0.05 mL and the density of water is 1.0 g/mL. How many water molecules are present in a drop of water?
   a. 1.7×10^{21}
   b. 5.4×10^{23}
   c. 2.2×10^{26}
   d. 1.71×10^{20}

15. Find the total number of electrons present in 1.6 g of CH_4.
    a. 6.023×10^{23} electrons
    b. 6.023×10^{20} electrons
    c. 10 electrons
    d. 1 electron

16. The number of gram atoms in 3.2 g of Ca:
    a. 3.2 g atoms
    b. 0.08 g atoms
    c. 0.8 g atoms
    d. 1.0 g atoms

17. The number of atoms in 1 mL of ammonia gas at STP is:
    a. 2.7×10^{19}
    b. 1.08×10^{20}
    c. 10.8×10^{20}
    d. 5.4×10^{19}

18. From 200 mg of CO_2, 10^{21} molecules are removed. How many moles of CO_2 are left?
    a. 2.88×10^{-3} mol
    b. 7×10^{-2} mol
    c. 2.88×10^{-1} mol
    d. 2.8 mol

19. How many years would it take to spend one Avogadro’s number of rupees at a rate of 10 lakh of rupees in one second?
    a. 8.65×10^{18}
    b. 1.91×10^{10}
    c. 6.023×10^{15}
    d. 3.81×10^{4}

20. If N_A is Avogadro’s number, then the number of valence electrons in 4.2 g of azide ions $N_3{}^-$ are:
    a. 4.2 N_A
    b. 2.4 N_A
    c. 1.6 N_A
    d. 3.2 N_A

21. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions are:
    a. 0.0093 moles
    b. 0.21 moles
    c. 2.10 moles
    d. 0.186 moles

22. 10 dm^3 of N_2 gas and 10 dm^3 of gas X at the same temperature contain the same number of molecules and have same mass, the gas X is:
    a. CO_2
    b. CO
    c. H_2
    d. NO

23. An element has the following natural abundances and isotopic masses: 90.92% abundance with 19.99 amu, 0.26% abundance with 20.99 amu and 8.82% abundance with 21.99 amu. Calculate the average atomic mass of this element.
    a. 80.52 amu
    b. 25.45 amu
    c. 15.89 amu
    d. 20.16 amu

24. Which of the following represents the least number of molecules?
    a. 20 g of H_2O (Molecular mass = 18.02 g/mol)
    b. 77 g of CH_4 (Molecular mass = 16.06 g/mol)
    c. 68 g of CaH_2 (Molecular mass = 42.09 g/mol)
    d. 100 g of N_2O (Molecular mass = 44.02 g/mol)

25. Find the number of moles in 3.00 g of boron tribromide BBr_3.

Answer Key

Question Number	1	2	3	4	5
Answer Key	(a)	(b)	(d)	(a)	(a)

Question Number	6	7	8	9	10
Answer Key	(b)	(d)	(c)	(c)	(d)

Question Number	11	12	13	14	15
Answer Key	(c)	(d)	(d)	(a)	(a)

Question Number	16	17	18	19	20
Answer Key	(b)	(b)	(a)	(b)	(c)

Question Number	21	22	23	24	25
Answer Key	(a)	(b)	(d)	(a)	6.1×10^{-3} mol

Solutions

1. (a)

In the 1^{st} oxide, the amount of X = 5 g and the amount of oxygen = 5 g
In the 2^{nd} oxide, the amount of X = 3.2 g and the amount of oxygen = 4.8 g
On fixing the mass of X at 5 g,
The amount of oxygen required in the 2^{nd} oxide $= \frac{4.8}{3.2} \times 5 = 7.5$ g
According to the law of multiple proportions, when we fix one element the other element will bear a simple ratio in both the compounds. Hence ratio of amount of oxygen used in both compounds is 5:7.5 or 2:3, hence illustrating the law.

2. (b)

The law of definite proportions states that a given chemical compound always contains its component elements in a fixed ratio by mass and does not depend on its source and the method of preparation.
Therefore, the ratio of H:O in water = 11.11:88.89 =1:8 which will be constant in any sample of water irrespective of the source and the method of preparation.

3. (d)

The law of multiple proportions states that if two elements form more than one compound between them, then the ratios of the masses of the second element which combine with a fixed mass of the first element will always be ratios of small whole numbers.

4. (a)

The elements A and B, on reaction form two compounds in different proportions and on fixing the amount of A, the ratio of amounts of B in both compounds bear a simple ratio which is illustrated by the law of multiple proportions.

5. (a)

A balanced reaction is an equation that has an equal number of each type of atoms on both sides of the arrow. The law of conservation of mass will be violated if the reaction is not balanced.

6. (b)

Let the mass of each compound, Na_2O (compound I) and compound II be 100 g.

Sodium % in compound I $= \frac{2\times23}{(2\times23)+16} \times 100 = 74.19$ %

Hence, remaining oxygen will be 25.81 %.

i.e. 25.81 g of O_2 reacts with 74.19 g of Na

Therefore, 1 g of O_2 reacts with $= \frac{74.19}{25.81} = 2.87$ g of Na

The percentage of sodium in the second compound = 59 % (given) and hence oxygen will be 41%.

Similarly, 41 g of O_2 reacts with 59 g of Na

Therefore, 1 g of O_2 reacts with $= \frac{59}{41} = 1.44$ g of Na

According to the law of multiple proportions, Na must react in a simple ratio

So, $\frac{Na_I}{Na_{II}} = \frac{2.871}{1.44} = \frac{2}{1}$

Hence compound II will be in 1:1 ratio of Na:O or Na_2O_2.

7. (d)

The reaction of potassium with isotopes of chlorine does not follow any of the mentioned laws and is a drawback of the law of constant proportions as no fixed ratio is obtained after a reaction with isotopes.

8. (c)

Combustion of propane:
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$
Gay-Lussac’s law of combining volume states that when gases react, they do so in volumes which bear a simple ratio to one another, and to the volume of the product(s) formed if gaseous, provided the temperature and pressure conditions remain constant,
In the above equation:
1 volume of propane yields 3 volumes of CO_2
So, 30 mL propane yields = 3×30 mL of CO_2 = 90 mL CO_2

9. (c)

Avogadro’s law states that an equal volumes of all gases under the same temperature and pressure conditions contain an equal number of molecules.

10. (d)
Gay-Lussac's law is only valid for gases. Therefore, reactants and products both must be gases.

11. (c)
Let the mass of each oxide be 100 g.
For I oxide:
Oxygen = 27.6 % (given)
Metal = 72.4 % (given)
Molecular formula = X_3O_4 (given)
Let atomic mass of X be 'a' g.
So, $\frac{3a}{3a+64} \times 100 = 72.4$; solving, we get 'a' = 56 g
For II oxide: oxygen is 30 g, so metal will be 70 g

So, the ratio of moles of X:O will be $\frac{70}{56} : \frac{30}{16} = 1.25:1.875$ or 2:3

Hence, the compound is X_2O_3.

12. (d)
The law of definite proportions states that a given chemical compound always contains its component elements in a fixed ratio by mass and does not depend on its source and the method of preparation.
As the molecular mass of $CaCO_3$ is 100 g, Ca present is 40 g
So, if 4 g of $CaCO_3$ is present, then Ca $= \frac{40 \times 4}{100} = 1.6$ g.

13. (d)
The postulates of Dalton's atomic theory are option (a), (b) and (c) whereas option (d) is a wrong statement.

14. (a)
As, Density $= \frac{\text{mass}}{\text{volume}}$
So, mass = 1.0 g/ml × 0.05 mL = 0.05 g
Using Avogadro's law, 18 g of H_2O contains 6.023×10^{23} molecules
So, 0.05 g of H_2O contains $= \frac{6.023 \times 10^{23}}{18} \times 0.05 = 1.67 \times 10^{21}$ molecules

15. (a)

Molecular mass of CH_4 = 16 g = 1 mole
Electrons in a molecule of $CH_4 = 6 + (1 \times 4) = 10$
So, 16 g of CH_4 contains $= 10 \times 6.023 \times 10^{23}$ electrons
In 1.6 g $= \frac{10 \times 6.023 \times 10^{23} \times 1.6}{16} = 6.023 \times 10^{23}$ electrons

16. (b)

Number of gram atoms $= \frac{\text{given mass}}{\text{molar mass}} = \frac{3.2}{40} = 0.08$ g atoms

17. (b)

1 molecule of ammonia has 4 atoms (1 N + 3 H)
22400 mL of volume is occupied by 1 mole of gas $= 4 \times N_A$ atoms
Then, 1mL of volume is occupied by $= \frac{4 \times N_A}{22400} = 1.08 \times 10^{20}$ atoms

18. (a)

1 mole of CO_2 has a mass of 44 g and contains N_A number of molecules.
So, 10^{21} molecules will be present in $= \frac{44 \times 10^{21}}{6.023 \times 10^{23}} = 0.0731$ g of CO_2 = 73.1 mg of CO_2

Remaining CO_2 will be = Initial amount - Removed amount = (200 - 73.1) mg of CO_2

Remaining $CO_2 = 126.946$ mg $= 126.946 \times 10^{-3}$ g

Number of moles CO_2 left $= \frac{\text{amount of } CO_2 \text{ left (g)}}{\text{molar weight (g)}} = \frac{126.946 \times 10^{-3}}{44} = 2.88 \times 10^{-3}$ moles

19. (b)

Rate of money spent = 10 lakh rupees per second = Rs 10^6/s
Now, Avogadro's number of rupees will be spent in $= \frac{\text{Avogadro's number}}{\text{Rate of money spent per sec}}$ s

$= \frac{6.023 \times 10^{23}}{10^6} = 6.023 \times 10^{17}$ s

1 year = 365 days = 365 × 24 hours = 365 × 24 × 3600 = 3.15×10^7 seconds
Therefore, number of years $= \frac{6.023 \times 10^{17}}{3.15 \times 10^7} = 1.91 \times 10^{10}$ years

20. (c)

Number of moles of azide ions $= \frac{\text{given mass}}{\text{molar mass}} = \frac{4.2}{42} = 0.1$ mole
Number of valence electrons in a nitrogen atom = 5
So, number of valence electrons in N_3^- = 3(5) +1 = 16
number of valence electrons in 0.1 moles $= 16 \times 0.1 \times N_A = 1.6\ N_A$

21. (a)
1 litre of air contains 21% of oxygen.
Total amount of oxygen in 1 L = 0.21×1 L = 0.21 L
At STP, 22.4 L volume is occupied by 1 mole of oxygen
So, 0.21 L is occupied by = $\frac{1 \times 0.21}{22.4}$ = 0.0093 moles

22. (b)
It is given that the gases are at the same temperature and volume conditions and contain the same number of molecules. We know, molecular weight of N_2 = 28 g
Therefore, moles of N_2 = moles of X (they have same number of molecules)
This is only possible when they have the same molecular weight.
Molecular weight of CO = 28 g.

23. (d)
Average atomic mass is given by:
$$\frac{(\text{atomic mass} \times \%\text{abundance})_1 + (\text{atomic mass} \times \%\text{abundance})_2 + (\text{atomic mass} \times \%\text{abundance})_3}{100}$$

$$= \frac{(19.99 \times 90.92 + 20.99 \times 0.26 + 21.99 \times 8.82)}{100} = 20.16 \text{ amu}$$

24. (a)
1 mole of a substances will have N_A number of molecules, so the molecule with the least number of moles will have the least number of molecules.
Number of moles: $\frac{\text{given mass}}{\text{molar mass}}$
For 20 g H_2O, number of moles = $\frac{20}{18}$ = 1.11 moles
For 77 g CH_4, number of moles = $\frac{77}{16}$ = 4.81 moles
For 60 g CaH_2, number of moles = $\frac{68}{42}$ =1.62 moles
For 100 g N_2O, number of moles = $\frac{100}{44}$ = 2.27 moles
As water has the least number of moles, hence it will have the least number of molecules.

25. 6.1×10^{-3} moles
Molar mass of BBr_3 = 11 + 3(160) = 491 g
Now 491 g of BBr_3 will contain 1 mole
So, 3 g will contain = $\frac{1}{491} \times 3 = 6.1 \times 10^{-3}$ moles